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Characterization of natural building granitic stones

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The market of building stones is an important and worldwide economic activity (e.g. ca. 760 M€ for France in 2006). Massive international exchanges do occur, with potential “misfits” between comparable stones of different origin. In addition, the workmanship is increasingly used in the industry, such as artificial colouring of stones for a higher selling price, bonding of two stones of different origin but with equivalent macroscopic characteristics, or chemical treatments of stones to hide discoloration caused by stains. It reveals therefore important to be sure of the origin of the rocks in order to have a guaranty of quality and provenance, as well as for security reasons (fake stones might not have the same resistance and/or qualities as their original counterparts). Moreover, in the case of restoration of historical monuments, it is convenient to use the same materials or materials as close as possible to the original ones.

The aim of this work is to establish an analytical protocol that permits to unequivocally ascertain that a given rock sample comes from a given quarry or massif and consequently provide a tool to guaranty the origin of the building stones. In this contribution, we focus on granitic rocks from French quarries and on their comparison with “analogue” ones from foreign countries (China and Spain). Beyond the macroscopic observations, the strategy combines different quantitative approaches: petrology, geochemistry and rock magnetic properties.

Results concern four French granitic stones: (1) the medium-grained "gray / blue" of Louvigné-du-Desert, (2) the medium-grained "blue" of Lanhélin, (3) the coarse-grained "pink" of La Clarté, and (4) the Tarn "Silverstar". For each target, 2-13 samples were extracted from 1 to 5 exploited quarries. Louvigné-du-Desert and Lanhélin quarries exploit granodiorites from two neighbouring late Cadomian intrusions in The Mancelian Province of northern Brittany. The granite from La Clarté quarries is part of the late-Hercynian Ploumanac’h massif, in the northern part of the Hercynian belt of Brittany. Rock from the Tarn belong the Sidobre massif, a late-Hercynian granite located in southern Massif Central.

The study of samples from these different quarries shows that the combination of petrological, geochemical and magnetic analyses is robust to distinguish building stones from massifs of different history but also from massifs of the same age and the same geodynamic setting. Our analytical procedure shows that granitic stones extracted from a given quarry or a given massif can be distinguished from foreign building stones having comparable appearance. Furthermore, results are the first elements for the constitution of a database for the characterization of French granitic building stones. Such a database should further improve the traceability of stones used for monuments, protecting historical sites and enhancing the geological heritage.